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WATER RESOURCE NEEDS AND APPROACHES TO INDUSTRIAL WASTE TREATMENT

FOR

APEX, NORTH CAROLINA

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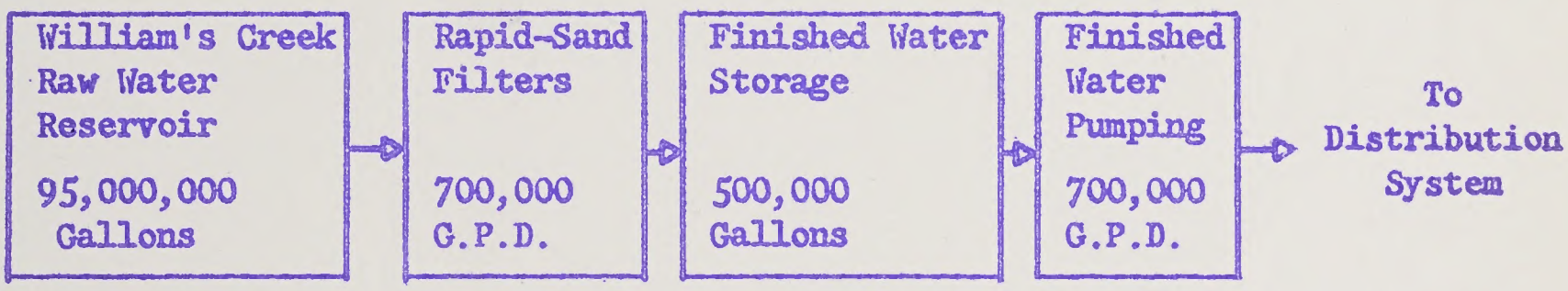
WATER RESOURCE NEEDS

Background Discussion

In 1967 the Town of Apex completed construction of expanded water treatment works designed to provide for the water needs of the town through 1975. Since completion of this project, the water demands of the town have completely outstripped the capabilities of the town's water treatment plant. During the past three summers it has been necessary to augment this source by drafting farm ponds and tapping Cary's system with an emergency pipe. The raw water storage lake spillway has been raised twice, but the yield of the lake's basin is virtually exhausted. The first portion of this memorandum will relate problems associated with Apex's water resource needs, and examine long and short range possibilities for their resolution; current investigations and efforts towards these solutions on the part of the town, the planner, and consulting engineer will be related.

Apex's existing water supply and treatment plant is comprised of the following components:



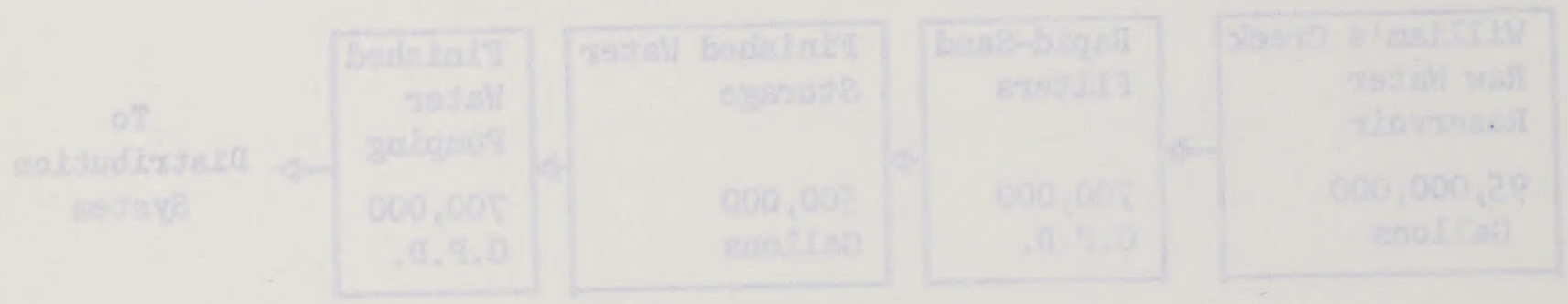
As illustrated in the diagram, the critical elements in the system are treated water storage with a 500,000 gallon capacity and filtration and pumping capability at a rate of 700,000 gallons per day. Because the reliable yield of the watershed (based upon a 10 year drought frequency) is approximately 600,000 gallons per day, the current water shortage cannot be resolved by expanding the existing treatment works; to do so would deplete the raw water reservoir during dry years at a rate faster than runoff in the basin would replace it, eventually draining the lake.

WATER RESOURCE NEEDS

Background Discussion

In 1967 the Town of Ajax completed construction of expanded water treatment works designed to provide for the water needs of the town through 1975. Since completion of this project, the water demands of the town have completely outstripped the capabilities of the town's water treatment plant. During the past three summers it has been necessary to augment this source by drafting farm ponds and tapping Cary's system with an emergency pipe. The raw water storage lake upstream has been raised twice, but the yield of the lake's basin is virtually exhausted. The first portion of this memorandum will relate problems associated with Ajax's water resource needs, and examine long and short range possibilities for their resolution; current investigations and efforts towards these solutions on the part of the town, the planner, and consulting engineer will be related.

Ajax's existing water supply and treatment plant is comprised of the following components:



As illustrated in the diagram, the critical elements in the system are treated water storage with a 500,000 gallon capacity and filtration and pumping capability at a rate of 700,000 gallons per day. Because the reliable yield of the watershed (based upon a 10 year drought frequency) is approximately 600,000 gallons per day, the current water shortage cannot be resolved by expanding the existing treatment works; to do so would deplete the raw water reservoir during dry years at a rate faster than runoff in the basin would replace it, eventually draining the lake.

The principle source of water demand has been rapidly increasing industrial consumption, largely Lufkin Instruments electroplating facility which commenced operation in August of 1967.

The graph following page 10 illustrates average daily water consumption by customers of the Apex system from 1960 to 1968, and projected average daily demand through 1990. As shown, the sharpest increase in water consumption occurred in 1967 with the advent of Lufkin's operations.

The impact of Lufkin's operations on Apex's water use is illustrated in the following table; Lufkin's consumption, steadily increasing over time, has varied from 0.4% of total use to 43.0%.

WATER USE - THE LUFKIN RULE COMPANY, APEX, NORTH CAROLINA

Month & Year	Apex Average Day (GPD)	Lufkin Average Day (GPD)	Percent of Water Use by Lufkin
8-67	225,000	1,000	0.4
9-67	232,000	6,700	2.9
10-67	255,000	22,300	8.7
11-67	231,000	10,000	4.3
12-67	270,000	30,000	11.1
1-68	282,000	42,000	15.0
2-68	281,000	39,000	14.0
3-68	266,000	57,000	22.0
4-68	290,000	80,000	28.0
5-68	330,000	76,000	23.0
6-68	401,000	100,000	25.0
7-68	488,000	136,000	28.0
8-68	434,000	180,000	41.0
9-68	389,000	136,000	35.0
10-68	329,000	127,000	38.0
11-68	300,000	120,000	40.0
12-68	293,000	100,000	34.0
1-69	306,000	81,000	27.0
2-69	330,000	143,000	43.0

SOURCE: Report on Additional Water Supply for Town of Apex, North Carolina, March 1969, L.E. Wooten and Company, Consulting Engineers, Raleigh, N.C.

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In 1969, a study of possible new sources of water supply was conducted by Apex's consulting engineering firm, L.E. Wooten and Company of Raleigh. Recognizing that the William's Creek watershed was exhausted, three alternate possibilities were examined in that study: 1) construction of a treatment plant and transmission line to provide water from the U.S. Army Corps of Engineers, New Hope impoundment in Chatham County; 2) purchase of water from Raleigh via Cary's system, (which in turn secures water from Raleigh); and 3) direct purchase of water from Raleigh. It should be noted that ground water resources were not considered because neither deep nor shallow wells yield usable quantities of water.[1] Possible pollution danger in the northern portions of the New Hope reservoir had not been brought to light at that time, and Raleigh's additional raw water storage on the Neuse was thought to be nearer in time when the report was prepared. The first and third alternatives were deemed financially infeasible, and the study recommended that the second alternative be employed.

Engineering plans for a connection to the Cary water system within McGregor Downs subdivision were prepared, and a grant-in-aid application was submitted to the U.S. Department of Housing and Urban Development in May of 1969 (subsequently approved). Cary's engineering consultants, in a study prepared in April of 1970, recommended that Cary sell water to Apex at $.417 per thousand gallons, and levy a minimum monthly charge of $900 regardless of actual use. After lengthy negotiations the minimum charge was deleted. The Town of Cary's agreement with Apex was made contingent upon Apex's making satisfactory arrangements with the developers of McGregor Downs. The firm initially required that Apex pay an acreage fee rebate of approximately $20,000 to reduce their cost for a water line from Cary crossing entirely undeveloped areas. Later this was modified to provide instead that Apex

---

[1] The Apex area is underlain by a broad belt of Triassic-period rock of the Newark group which terminates at the Jonesboro Fault in the east and in Granville County in the north. This group is an extremely poor aquifer, yielding an average of 6 GPM to 84 wells tested by the Department of Water and Air Resources; 15 of these yielded less than 1 GPM. Ground water produced from this region is generally quite hard.

In 1969, a study of Honduras' water supply was commenced by the U.S. Department of Housing and Urban Development in May of 1969 (expeditiously approved). Cerro's engineering consultants, in a study prepared in April of 1970, recommended that Cerro sell water to Apax at $.114 per thousand Gallons, and that a minimum monthly charge of $900 represent one year's minimum revenue. Water tankers/vehicle operations and maintenance charges were deducted. The water tariff of Cerro's agreement with Apax was made contingent upon Apax's maintaining satisfactory arrangements with the guarantors of Hydroelectric power. The firm initially reported that Apax had an average rate capacity of approximately $50,000 to reduce debt cost for a water line from Cerro crossing entirely unsatisfactory areas. Later rates were modified to provide funds that Apax

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[1] The Apax area is supplied by a bund pole of Tiltrate-bearing rock of the Jorsapore family in the east and the Jorsapore family in the west. Apax group water terminates at the Jorsapore family in the east and is generally dumb in the north. Into Cerro is an extremely poor aquifer, highlighted as wastage of 6 MGM to 48 MGM to Apax tested by the Department of Water and Air Resources; 15 of these highlighted less than 1 GPM. Cerro's water production is generally dirty brid.

Engineering Plans for a connection to the Cerro water system which included pumps and a transmission main were prepared, and a transmission main was completed.

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Recognizing that the Apax's Cerro Aqueduct was exhausted, three alternative possibilities were examined in that study: 1) construction of a treatment plant and transmission line to bring water from the U.S. Tank Corps of Engineers' Water Tank in Cerro's system; 2) Increase of water flow from Jorsapore Cerro's system (which in turn receives water from Jorsapore); and 3) direct New Pole improvement in Cerro's system. It should be noted that Cerro water resources were not considered because neither Cerro nor Apax's City Hall has jurisdiction over the Jorsapore aquifer. Jorsapore boundaries queued in the northern portions of Cerro's system, and the two aquifers are highly interdependent.

Apax's consultant engineers from L.E. Moore and Company of Jorsapore. Recognizing that the Apax's Cerro Aqueduct was exhausted, three alternative possibilities were examined in that study: 1) construction of a treatment plant and transmission line to bring water from the U.S. Tank Corps of Engineers' New Pole improvement in Cerro's system; 2) Increase of water flow from Jorsapore Cerro's system (which in turn receives water from Jorsapore); and 3) direct

Increase of water flow from Jorsapore. It should be noted that Cerro water resources were not considered because neither Cerro nor Apax's City Hall has jurisdiction over the Jorsapore aquifer. Jorsapore boundaries queued in the northern portions of Cerro's system, and the two aquifers are highly interdependent.

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install 2,000 feet of 12" water main along Kildare Farm Road within the subdivision (which would constitute an essential link in the delivery system to Apex). Costs resulting from the need to install an additional 1,100 feet of pipe and an increase in cost of pumping equipment simultaneously added $13,000 to the project cost. These arrangements were felt to be wholly unsatisfactory by the Town of Apex, which requested that the project planner discuss with HUD a possible amendment of the grant-in-aid to connect directly to the Raleigh water system. HUD's Metropolitan Development Section indicated that they would not favorably entertain such a request since they considered the extra distance required to reach Raleigh's system as excessive, representing illogical system development and unnecessary expense, giving little consideration to the higher water rate associated with connecting through Cary's system as well as capital items required by McGregor Downs (costs which were arrived at considerably after HUD's grant was awarded, and which would have to be borne entirely by Apex). The chief advantage in connecting to Raleigh directly is the elimination of Cary's transmission surcharge, since the 20 year costs of the alternatives are relatively close, but thereafter the operating cost for water purchase varies substantially, as shown on the following page.

CUMULATIVE COSTS COMPARISON

	CONNECTION TO CARY SYSTEM VIA McGREGOR DOWNS SUBDIVISION - HUD GRANT OF $47,000			CONNECTION TO RALEIGH WITH HUD GRANT OF $47,000 [Amendment of Existing Grant]			CONNECTION TO RALEIGH WITH HUD GRANT OF $177,550 - [New Submission]		
	Water Cost[1]	Debt Service	Total	Water Cost	Debt Service	Total	Water Cost	Debt Service	Total
ANNUAL COST YEAR 1 - YEAR 20	45,700	5,200	50,900	24,000	21,000	45,000	24,000	19,000	43,100
TOTALS YEAR 20	914,000	104,000	1,018,000	480,000	420,000	900,000	480,000	380,000	862,000
ANNUAL COST THEREAFTER	45,700	-0-	45,800	24,000	-0-	24,000	24,000	-0-	24,000

[1] Assumes constant draw of 250,000 GPD and no rate modifications.

SOURCE: Data updated from L.E. Wooten Engineering estimates of September 3, 1970.

CUMULATIVE COSTS COMPARISON

	CONNECTION TO CARY SYSTEM VIA McGREGOR DOWNS SUBDIVISION - HUD GRANT OF $47,000			CONNECTION TO RALEIGH WITH HUD GRANT OF $47,000 [Amendment of Existing Grant]			CONNECTION TO RALEIGH WITH HUD GRANT OF $177,550 - [New Submission]		
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SOURCE: Data updated from L.E. Wooten Engineering estimates of September 3, 1970.

Apex's Future Water Needs

Before examining other alternatives to the solution of Apex's water needs, it is appropriate to reassess future water needs as they appear today. (Average daily water consumption in July of 1971 is approximately 180,000 gallons higher than the projected demand computed in the earlier engineering study. This is due both to industrial use and accelerated population growth not anticipated at that time.)

1) Normal Consumption including household, commercial and industrial processing requirements;

2) Fire Flow Reserves sufficient to extinguish a major fire without depleting finished water storage required for normal consumption.

Because industrial consumption on the part of Lufkin Industries electroplating installation constitutes the system's largest demand, the needs of this industry will be considered apart from demand of other sources of normal demand.

Normal Consumption

Normal consumption will be defined for purposes of this analysis as all sources of water demand exclusive of Lufkin Industries, and fire-flow demand. Normal consumption in Apex can be determined by examining water use data prior to Lufkin's opening in August of 1967. Average daily consumption during that period was 216,800 gallons, and the population[1] estimated at 1,728, resulting in per capita daily consumption of 125 gallons, a normal level for urbanized areas without large volume-use industry. As the level of living has risen in the United States, so has the demand for water to operate dishwashers, clothes washers, and watering lawns also risen. Apex's per capita normal consumption demand can be expected to increase through time and produce the water needs indicated below:

---

[1] Interpolated from 1966 special Census and 1970 census final population counts.

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---

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NORMAL CONSUMPTION WATER NEEDS, APEX, N.C. - 1975 - 1995

YEAR	PROJECTED POPULATION[1]	PER/CAPITA/DAILY CONSUMPTION (GALLON)	NORMAL CONSUMPTION (GAL/DAY)
1971	2,273[2]	154	350,750
1975	2,600	130	338,000
1980	3,000	135	405,000
1985	3,500	140	490,000
1990	4,000	145	580,000
1995	4,400	150	660,000

[1] See Appendix A for discussion of Apex population projections.

[2] Interpolated from 1970 Census and 1975 projection.

The Lufkin Rule Company

Officials of the Lufkin plant have indicated that the plant's water needs can be expected to increase at a rate of approximately 15% annually, until 1975, when the plant will be consuming approximately 300,000 GPD. This figure represents the maximum consumption which the plant can utilize unless sizeable expansion or changes in processing techniques occur, neither of which is foreseen at this time.

Fire Flow Reserves

Fire flow reserves represent the capacity of water which must always be available (either as finished water storage or as delivery capability via a large transmission line from another municipal water supply) for extinguishing a major fire without depleting storage of finished water necessary for normal consumption. Standards for the maintenance of adequate fire flow supply have been developed and promulgated by the American Insurance Association based upon population:

Population:

been developed and promulgated by the American Water Works Association based upon consumption. Standards for the maintenance of adequate fire flow are vital to the economic health of the nation.

Fire Flow Reserves

Fire flow reserves represent the capacity of water which must exist in excess of average daily water requirements to be delivered through a given distribution system at a given pressure. Fire flow reserves are to be delivered through hydrants and be available (stored as finished water storage or as delivery capacity from a large transmission line with sufficient capacity to deliver water necessary for normal demand plus fire flow requirements.

The Indian Hills Company

Optimists of the Indian Hills Company have calculated that the Company's water needs when the Company will be completed approximately 300,000 GPD. Fire flows can be expected to increase at a rate of approximately 12% annually from 1982 to 1992 and remain constant thereafter.

YEAR	POPULATION[1] PROJECTED	(GALLON) CONSUMPTION PER\CAPITA\DAYS	(GAL\DAY) CONSUMPTION MONTHLY
1981	3,515	124	320,150
1982	3,600	130	338,000
1983	3,800	135	405,000
1984	3,900	140	450,000
1985	4,200	145	580,000
1986	4,400	150	660,000

MONTHLY CONSUMPTION WATER NEEDS, YEAR, N.C. - 1981 - 1986

[1] See Appendix A for discussion of Area Population Projections.

[2] Interpolated from 1980 Census and 1982 Projection.

AMERICAN INSURANCE ASSOCIATION FIRE FLOW REQUIREMENTS

POPULATION	HOURS DURATION	RATE GPM	TOTAL REQUIRED (GALLONS)
2,000	6	1,500	540,000
3,000	7	1,750	735,000
4,000	8	2,000	960,000
5,000	9	2,250	1,215,000
6,000	10	2,500	1,500,000
10,000	10	3,000	1,800,000

SOURCE: Modified from Principles and Practices of Urban Planning, Goodman and Freund, p.223.

Interpolation of the requirements established above to the projected population for Apex results in this demand schedule:

FIRE FLOW WATER REQUIREMENTS, APEX, N.C. - 1975 -1995

YEAR	POPULATION PROJECTED	FIRE FLOW REQUIREMENTS
1975	2,600	675,000
1980	3,000	735,000
1985	3,500	847,000
1990	4,000	960,000
1995	4,400	1,062,000

Summary Water Needs Evaluation

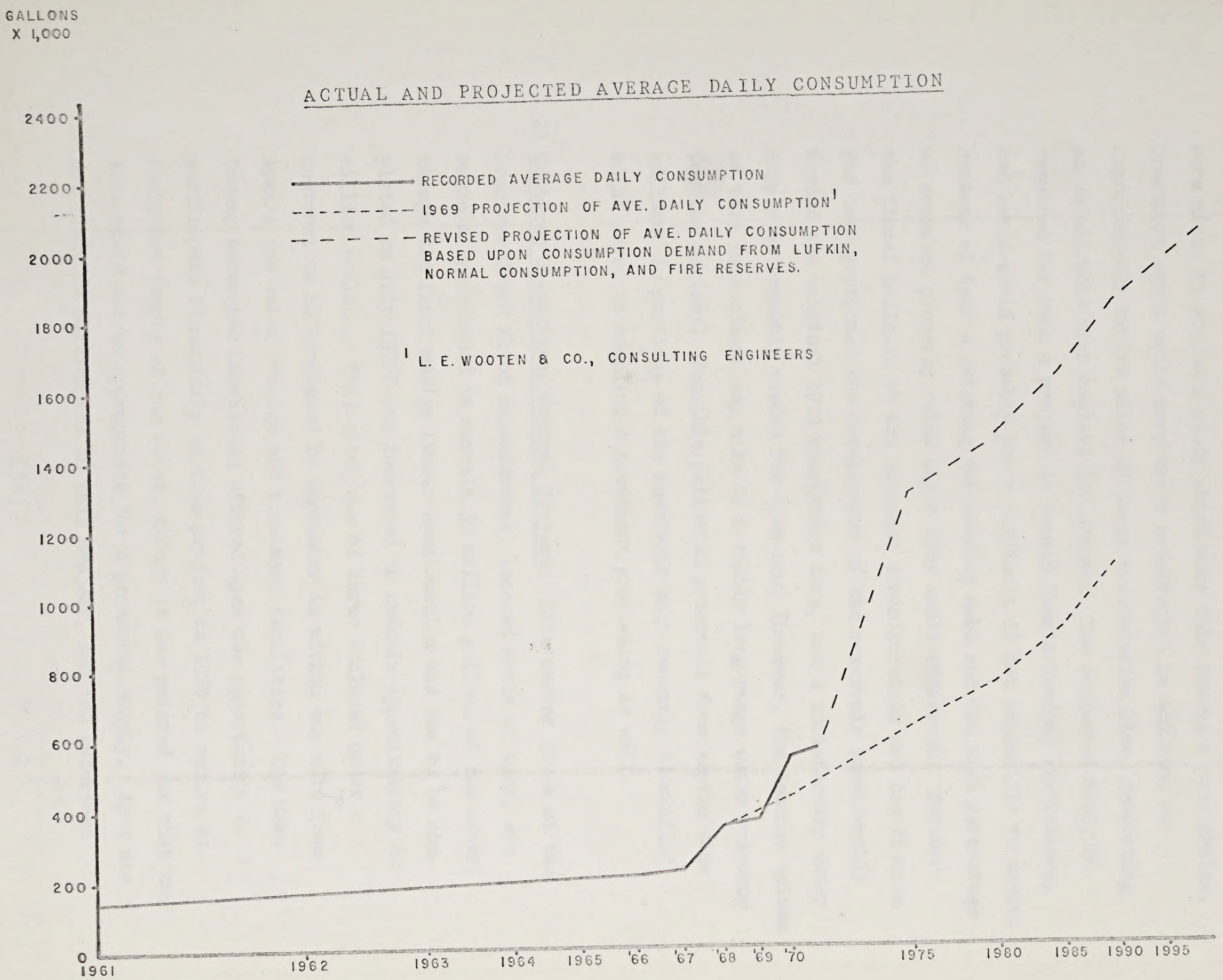
Considering together the three sources of water demand discussed above, Apex may anticipate total water demand during the coming twenty year period according to the following schedule:

APEX, NORTH CAROLINA, WATER NEEDS

1975 - 1995

YEAR	NORMAL CONSUMPTION (gal)	LUFKIN RULE COMPANY (gal)	FIRE FLOW (gal)	TOTAL (gal)
1975	338,000	300,000	675,000	1,313,000
1980	405,000	300,000	735,000	1,440,000
1985	490,000	300,000	847,000	1,637,000
1990	580,000	300,000	960,000	1,840,000
1995	660,000	300,000	1,062,000	2,022,000

Comparing these estimates with the estimated demand schedule prepared in 1969, considerably higher water demand appears to be in store than originally anticipated.


GALLONS
X 1,000
ACTUAL AND PROJECTED AVERAGE DAILY CONSUMPTION
RECORDED AVERAGE DAILY CONSUMPTION
1969 PROJECTION OF AVE. DAILY CONSUMPTION[1]
REVISED PROJECTION OF AVE. DAILY CONSUMPTION BASED UPON CONSUMPTION DEMAND FROM LUFKIN, NORMAL CONSUMPTION, AND FIRE RESERVES.
[1] L. E. WOOTEN & CO., CONSULTING ENGINEERS
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1961
1962
1963
1964
1965
'66
'67
'68
'69
'70
1975
1980
1985
1990
1995

Alternatives for a Permanent Water Supply

1) New Hope Dam and Reservoir. Although the New Hope project offers the advantage of already being under construction, several factors were cited in Wooten's study which make this source a poor choice. Treatment works would have to be constructed in addition to approximately twelve miles of large transmission line, generating an undesirable high capital investment. The estimated $900,000 required for such a project is beyond Apex's bonding limitations, and bonds would probably prove difficult if not impossible to market because of Apex's existing outstanding debt and the high percentage of assessed property value which they would represent. Further, the fiscal policies of the national administration and the Vietnam War have postponed the development of the reservoir considerably beyond the original 1973 completion date, and a satisfactory water supply is urgently needed for Apex now, (however, the immense volume of this impoundment may make it a viable long-range water resource for the region). Possible pollution potential from septic tank effluent in portions of the reservoir only recently identified might serve to complicate treatment processing as well.

2) Crabtree Creek Flood Control Project. Site number three of the Crabtree Creek flood impoundments, located north of Apex, was orginially designed to contain 30 million gallons of raw water, though the final design (under construction and due to be completed in July 1971) was increased to contain approximately 60 million gallons. This site, one of three included under a contract to be completed by September is within one mile from Apex's raw water storage and treatment facilities. The Wake County Watershed Commission offered Apex the opportunity to participate financially in this project in 1970 to secure an emergency supply of raw water, though it was pointed out that the site would not be appropriate for a permanent supply. Apex did not elect to participate in this project, and the watershed

commission consequently obtained title only to land rights, sufficient to permit the inundation of privately-held lands, rather than securing fee simple titles.

If Apex wishes in the future to obtain emergency water from this source, the town will have to negotiate with the Watershed Commission as well as holders of titles under the waters. Because of these complications the utilization of this impoundment (which would require treatment) may prove impractical.

3) Raleigh Water System at U.S. 1. The City of Raleigh has extended a 12 inch finished water transmission main to the intersection of U.S. 1 and Cary-Macedonia Road to provide water to the Town of Cary. The principal advantages to using this source is the low per-unit cost of water purchased directly from Raleigh and the obviation of capital investment for a treatment plant. The chief disadvantage include both a high capital cost which might result in unmarketable bonds and HUD's refusal to consider this route in spite of its lower 20-year cost (relative to costs for connection through Cary entailing an additional transmission surcharge).

4) White Oake Cooling Lake. Carolina Power and Light Company has begun land assembly for construction of a nuclear-fueled electric power generating plant to be located in southwestern Wake County; associated with the plant will be a large lake to be used for cooling water heated by the nuclear pile to drive stream turbines before discharge into natural channels, where the heat would otherwise result in significant ecological imbalances. Waters feeding this impoundment are not currently classified for use as a source of public drinking water, according to the N. C. Department of Water and Air Resources. However,

the stream which will feed this lake has inadequate flow to provide sufficient water for the cooling process; consequently pumping of additional water from the Cape Fear River will be necessary to its operation. Under these circumstances, it is improbable that the cooling lake will prove to be an economical source of raw water, if available at all. Capital investment in treatment facilities would be necessary if this alternative proved viable, and its completion date effectively removes this alternative from short-range need consideration.

5) Connection to Raleigh System via Cary. Apex's experiences toward carrying out this recommended approach, involving continuing negotiations between Apex, L. E. Wooten and Company, the Town of Cary, Moore, Gardner and Associates, the City of Raleigh, McGregor Downs, and HUD, have been set forth earlier. This approach has as its chief merits a low capital investment and no treatment plant requirements, but entails a higher water rate than any of the other propositions, resulting in a higher 20-year cost than the longer route to Raleigh.

Since HUD has committed $47,000 to the construction of such a transmission system, and the development of other permanent sources would be costly because of inflation due to delay and the pressing water need which exists today, this represents the most feasible solution at this time. There is also the possibility that the twenty-year cost of this proposal may be lowered in the future if recommendations for county-wide water and sewer service are followed by Wake County. The consulting engineers of Wake County's municipalities and the City of Raleigh Engineering Department have been engaged in the preparation of a county water and sewer service study for Wake County (funded by the Farmer's Home Administration of the U.S. Department of Agriculture) during the past year. When published, the study will contain recommendations for financial participation in extended water and sewer service by

the county and the establishment of uniform water charges throughout Wake County which, if adopted, would standardize wholesale water rates for purchasers throughout the system (Cary and Garner already purchase finished water from Raleigh, and Garner utilizes Raleigh's Walnut Creek sewage disposal facilities) eliminating the high double surcharge Apex must pay under the terms of the existing agreements between Cary, Raleigh and Apex.

Comparison of Source Alternatives

SOURCE	TREATMENT REQUIRED?	ADVANTAGES	DISADVANTAGES
1) New Hope Dam	Yes	Relatively unlimited supply	1) Excessive distance 2) Treatment Required 3) Distant Completion Date 4) Possible extra-treatment required because of development in basin. 5) Bond sales feasibility
2) Crabtree Creek Flood Control Impoundment	Yes	1) Relative proximity to Apex treatment plant. 2) Construction almost completed.	1) Treatment required 2) Legal complications of land and water rights. 3) Inadequacy of supply for more than emergency use.
3) Raleigh Water System	No	1) Low-unit cost of water 2) Relative proximity to Apex 3) Finished water delivered to Apex	1) HUD's stance on project
4) White Oak Cooling Lake	Yes	1) Relative proximity to Apex	1) Treatment plant required 2) Distant completion date 3) Limited supply and possible unavailability for municipal supply
5) Connection to Cary Water System	No	1) Approved HUD grant-in-aid 2) Finished water delivered to Apex	1) High unit cost of water

THE CARY TAP

Consideration of Other Possible Routes

Because of the added costs entailed in connecting to McGregor Downs' system and higher costs which have resulted from inflation since the project was begun, the examination of other possible connection points to the Cary system seemed in order. Working with Apex's attorney, Carl Holleman, the Fred Davis Engineering firm of Raleigh, and consulting engineer, Willis Barlowe of L. E. Wooten and Company, the planner investigated the feasibility of other possible routes. Town officials felt that easements could possibly be obtained across a large parcel either to a new subdivision in Cary (Scottish Hills) or to create a shorter route to McGregor Downs, eliminating portions of line necessary to use existing rights-of-way where easements were certain. The respective routes investigated are mapped on the following page and approximate, relative costs for each shown.

COMPARISON OF COSTS OF ROUTES TO CARY WATER SYSTEM

	[A] McGREGOR DOWNS [ORIGINAL]	[B] McGREGOR DOWNS	[C] THROUGH HOLT TO SCOTTISH HILLS	[D] THROUGH HOLT TO SCOTTISH HILLS
12" pipe @$8.80/l.f.	$ 65,000	$ 42,000	$ 62,500	$ 71,000
Pumping Station	34,000	34,000	34,000	34,000
Estimated Construction Cost	$ 99,000	$ 76,000	$ 96,500	$105,000
Construction Contingency	5,000	4,000	5,000	5,000
	$104,000	$ 80,000	$101,500	$110,000
Engineering	8,500	6,000	7,500	8,000
Legal	1,000	1,000	1,000	1,000
Government Field Expense	1,000	1,000	1,000	1,000
Audit	500	500	500	500
To McGregor Downs	12,000	12,000	-0-	-0-
Land	2,000	-0-	-0-	-0-
	$129,000	$100,500	$111,500	$120,500
Federal Grant	-47,000	-40,000	-47,000	-47,000
Town's Share	$ 82,000	$ 60,500	$ 64,500	$ 73,500

SOURCE: L. E. Wooten and Company.

CONVERSION OF CITIES TO ACCESS TO NATIONAL DATA SYSTEM

	STATE MESSAGE SWITCHING	STATE MESSAGE SWITCHING	SMALL MODERN SWITCH	LARGE (DIGITAL) SWITCH
	[D]	[E]	[F]	[G]
Total Cost	$ 14,000	$ 19,000	$ 40,000	$ 52,000
Equipment Costs	42,000	42,000	40,000	42,000
	54,000	61,000	80,000	94,000
Line	-0-	-0-	-0-	3,000
To Modular Power	-0-	-0-	12,000	12,000
Plant	500	500	500	500
Government Level Charges	3,000	3,000	3,000	3,000
Legal	1,000	1,000	1,000	1,000
Engineering	2,000	2,000	4,000	2,000
	$ 60,500	$ 68,000	$101,500	$115,500
Contingency Contingency	2,000	2,000	5,000	2,000
Cost	$ 62,500	$ 70,000	$106,500	$117,500
Estimated Conversion				
Employee Savings	34,000	34,000	34,000	34,000
Net Pay Back Period	2.5 yrs	2.5 yrs	3.1 yrs	3.4 yrs

Because of the added costs associated to Modular Power, Conversion of Cities Multiple Modes

THE DATA ARE

Data and subsequent estimated costs for each phase.

Conclusion: The preceding cost comparisons are based on the following

Locations of lines necessary to use existing light-of-way where economic sense

(Secretary Utility) or, to change a signal tone to modular power, estimated

be optimal where a little battery option to a new multiplexer in card

of other possible choices. Some optimists note that economics could possibly

functions of L. L. Moore and Company, the dynamic transcription and identifying

first have philosophical type of patterns and consistent endpoint. Either

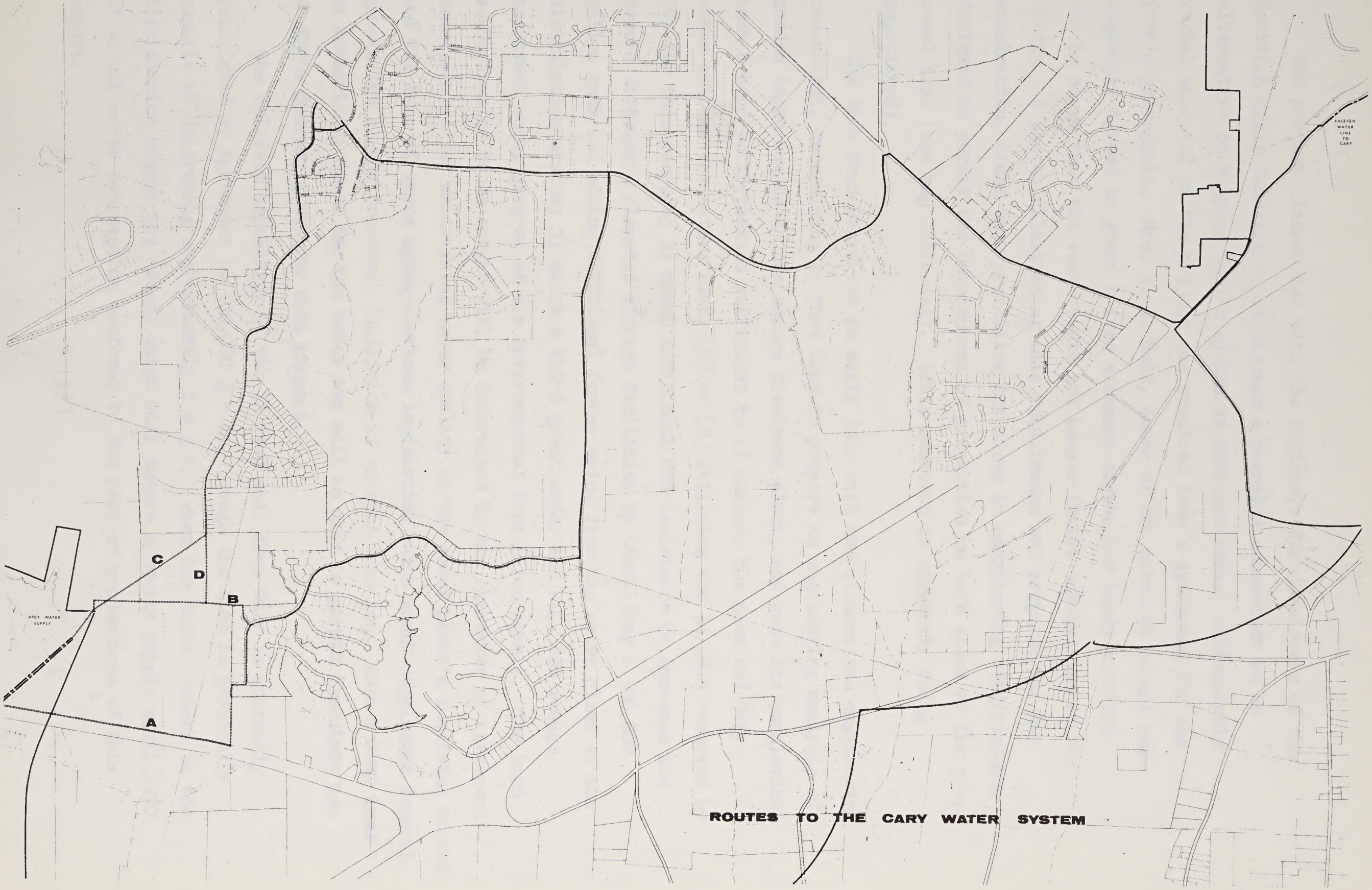
always assume, in order: Although after phase's stations' only outlines, the

are paying the conversion of other possible connection boxes to the card.

Phase and higher costs which were received from multiplexer since the budget

Because of the added costs associated to Modular Power,

Conversion of Other Possible Modes



ROUTES TO THE CARY WATER SYSTEM

The project planner met with the engineers for developers of the Scottish Hills Subdivision to discuss a possible connection as an alternative to tapping Cary's system at McGregor Downs; subsequently verbal approval of the project was received from a spokesman for the firm's principals. Mrs. J. E. Holt, owner of the critical parcel subsequently agreed to grant a free easement across her lands provided she be shown that the route would not hamper future subdivision of the tracts. A sketch illustrating this requirement was prepared for her examination, based upon prevailing lot sizes in neighboring subdivisions, designed to permit the development of properties on both sides of the proposed line (see map following). (This easement is currently being negotiated).

The Apex Town Board met in early July with the planner and engineering consultant, determining at that time to prepare an engineering analysis of needed improvements to the sewage treatment plant, and upon its completion seek a bond authorization sufficient to 1) connect the Apex and Cary water systems via either route [B] or [D] utilizing the $47,000 reserved by HUD for this purpose; 2) match additional HUD assistance to increase the town's inadequate elevated storage facilities by installing a 500,000 gallon tank and adding additional feeder mains from the water plant to the distribution system; 3) match a third grant under the P.L. 660 sewage treatment works program of the Environmental Protection Agency. The bond authorization to be sought will be determined by the character of treatment necessitated for maintaining water quality in the sewer plant's receiving stream and the fate of state appropriations legislation which would supplement federal grants for sewage treatment facilities if enacted into law. Once a bond issue is authorized, bonds for the water tap will be sold to permit immediate use of HUD's current grant for this purpose.

The delivery capability of the 12 inch main from Cary is currently restricted by agreement to 500,000 g.p.d., though the line is physically capable of delivering approximately 2 m.g.d. (when the extra feeders to the distribution system are added) which will insure adequate supply until 1990 if actual water consumption conforms to the revised projections of this report.

Results:

If actual water consumption conforms to the varied projections of this

distribution (where one added) which AIT finance expenses apply until 1991

consists of qualitatively substantially 1 m.3.d. (when the extra needs to the

resulting of efficiency to 200,000 of 1.b.q.3 though the line is hydraulically

The critical component of the 11 km main from Cwm is certainly

M. HWD.s CONTENT TRANS FOR THE PURPOSE:

Is satisfactory? Does the water pump AIT be able to handle transients and

UHE for this purpose? 2) Match additional HWD reservoirs to increase the

200,000 m.3 of available storage facilities by installing a

total, a fundamental circuit storage facilities of the water hydraulic to the

Dallon tank has adequate additional needs water from 1.L.V and 600 sample

distribution where) 3) match a third trans model the V.L. 600 sample

flowing model problem of the Environmental Protection Agency. The pump

simplification to be sought AIT be determined by the structure of circuit

necessitated for mechanical water. Simply in the **water hydraulic** reserve

and the rate of water hydraulic transients higher model supplement needs

Thus for solar circumstances facilities is obtained this 1km. Once a pump

is satisfactory? Does the water pump AIT be able to handle transients and

M. HWD.s CONTENT TRANS FOR THE PURPOSE:

The critical component of the 11 km main from Cwm is certainly

restricted by efficiency to 200,000 of 1.b.q.3 though the line is hydraulically

consists of qualitatively substantially 1 m.3.d. (when the extra needs to the

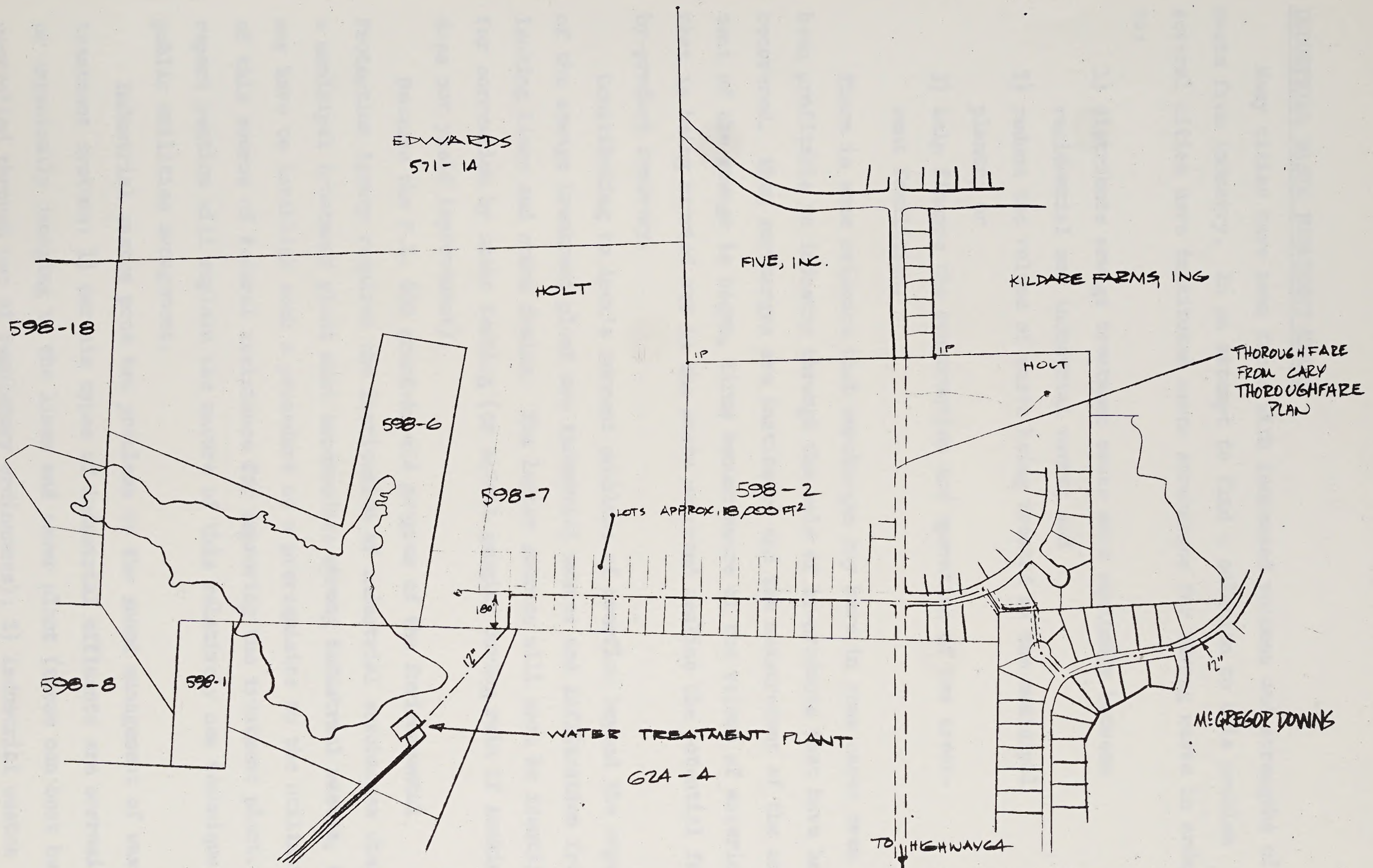
Dallon tank) AIT finance expenses apply until 1991 (where one added) which

distribution where) 3) match additional HWD reservoirs to increase the

200,000 m.3 of available storage facilities by installing a

total, a fundamental circuit storage facilities of the water hydraulic to the

Dallon tank has adequate additional needs water from the V.L.



PROPERTY OF J. E. HOLT SHOWING PROPOSED APEX WATER TRANSMISSION LINE

NOTE: THIS PLAN DOES NOT REFLECT AREA TOPOGRAPHY [NO QUAD SHEETS AVAILABLE] THUS ACTUAL LAYOUT SHOULD BE DESIGNED TO ACCOMODATE GRAVITY FLOW SEWERS.

INDUSTRIAL WASTE TREATMENT NEEDS

Many cities have been faced with increased volumes and strengths of waste from industry. In an attempt to find a solution to this problem several cities have instituted sewer surcharges for strong waste in order to:

1) distribute sewage treatment costs more equitably between residential and industrial users; and
2) reduce the volume of waste being treated by the municipal plants; or
3) help finance the construction and operation of new treatment facilities.

There is some evidence that surcharges may have in some cases even been profitable to industry through the sale of by-products that have been recovered. When surcharges are instituted and the measurement of the content of the sewage is begun, firms become aware of the volume of material that is being carried out in the waste waterand realize the potential for by-product recovery.

Contributing to Apex's current problems of overflow beyond the capacity of the sewage treatment plant are industrial wastes and infiltration from leaking lines and storm drains. The latter sources will soon be identified for correction by smoke testing (or actual gauging during rain if smoking does not yield improvement).

Because the P.L. 660 grant-in-aid program of the Environmental Protection Agency requires the institution of industrial surcharges where a municipal treatment plant must accommodate strong industrial wastes, the town may have to establish such a procedure as a prerequisite to the utilization of this source of federal assistance for improving the treatment plant. This report section will explain the nature of this relatively new technique of public utilities management.

Industrial wastes pose two problems to the sound management of waste treatment systems: 1) certain types of industrial effluents are corrosive or organically damaging to the lines and sewer plant (these can best be controlled through use of regulatory ordinances); 2) industrial wastes

INDUSTRIAL WASTE TREATMENT PLANTS

Many states have been faced with increased volumes and strengths of waste from industry. It is an attempt to find a solution to this problem several states have instituted sewer surcharges for strong waste in order to recover a portion of the cost of the waste treatment plant. These charges are instituted and the measurement of the contribution of industry through the sale of by-products that have been been traditionally to industry through the sale of by-products that have been recovered. Such surcharges are instituted and the measurement of the contribution of the volume of material treated by the municipal treatment plant. Some examples are given below.

Since the P.L. 660 grant-in-aid program of the Environmental Protection Agency requires the construction of industrial surcharges where a municipal treatment plant must accommodate strong industrial wastes, the same can be established such a procedure as a prerequisite to the application of this source of federal assistance for improving the treatment plant. Most report sections will explain the status of such relatively new requirements of implementation.

Industrial wastes pose two problems to the sound management of waste treatment systems: 1) certain types of industrial effluents are corrosive to mechanically damaging to the sewer pipe (those can pose a health hazard to the sewer system); 2) industrial wastes contribute through use to pollution overloads.

generally do not "pay their way" because of their high B.O.D. concentrations or high proportions of suspended solids, requiring substantially greater treatment processing per unit volume than other contributors to the system (with the exception of select commercial operations such as laundries). This inequity can be remedied by the institution of surcharges based upon BOD[1] or suspended solids concentration. Under these circumstances industries will in many instances pretreat fluid wastes to recover salable by-products and reduce surcharge costs. A 1970 survey by the International City Management Association indicated that eleven percent of 1,160 cities surveyed were then employing industrial surcharges. Periodic sampling of actual effluent is used to determine rates.

Greensboro is the only North Carolina city with extensive experience in this field (Durham and Charlotte have recently begun use of this method). Though surcharges account for only 2 percent of the systems revenues, in 1968-1969 Greensboro's surcharge program returned $6.35 for each dollar spent on sampling, monitoring, and the work required to collect the surcharge. The system has been in use since April of 1962. Greensboro levies a surcharge on strong wastes, defined as suspended solids or BOD in excess of 300 parts per million (ppm). Household wastes contain roughly 200 ppm B.O.D.). The B.O.D. threshold varies from 200 to 500 ppm and suspended solids from 240 to 800 ppm in cities identified as employing surcharges by Don Ethridge in "Water and Sewer Charges: Their General Nature and Effects."[2] Greensboro charges $02.2 per pound for BOD in excess of 300 ppm and $01.5 per pound for excess suspended solids.

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[1] Biochemical Oxygen Demand (BOD) is a universal measure of treatment required to reduce oxygen demand from wastes of organic character; sewer plant efficiency is frequently expressed as a percentage of BOD removal.

[2] Contained in Proceedings: Workshop on Water and Sewer Charges as Related to Water Use and Waste Control, Water Resources Research Institute of the University of North Carolina, 1969.

[1]Microbial oxygen demand (BOD) is a universal measure of treatment technical to reduce oxygen demand from wastes of organic origin: sewage, brewery effluent is traditionally expressed as a measure of BOD remaining.

[2]Contained in Proceedings: Workshop on Water and Sewage Charges as Related to Water Use and Waste Control. Water Resources Research Institute of the University of North Carolina, 1969.

an strong wastes" defined as unsaponified solids of BOD in excess of 300 parts per million (ppm). Domestic wastes contain roughly 300 ppm B.O.D.). The B.O.D. exceeds 1000 ppm and unsaponified solids from 500 to 800 ppm in cities identified as employing unsaponified pH non Raleigh in water and sewer charges: their current Matrix and Effects".[2] Greensboro charges 205.5 per pound for BOD in excess of 300 ppm and 104.5 per pound for excess unsaponified solids.

Greensboro is the only North Carolina city with extensive experience in the state field (Durham and Charlotte have recently begun use of this method). Although surcharges account for only 5 percent of the wastes treatment in 1968-1969 Greensboro's surcharge program recovered $0,35 for each dollar spent on assembling monitoring and the work required to collect the surcharge. The system has been in use since April of 1968. Greensboro levies a surcharge if the waste exceeds 300 ppm B.O.D. concentrations or if the waste contains more than 300 ppm suspended solids. Greensboro charges for waste flows from other contributors to the system (with the exception of select commercial operations such as laundries). Some industry can be removed by the installation of surcharges based upon BOD_5 or suspended solids concentration. Under these circumstances industries will be unable therefore primarily aimed to recover surcharge pay-backs and reduce surcharge costs. A 1970 survey by the International City Management Association indicated that eleven percent of 1,100 cities surveyed were then employing industrial surcharges. Controlled sampling of sewage effluent is used to determine rates.

Greensboro is the only North Carolina city with extensive experience in this field (Durham and Charlotte have recently begun use of this method). Although surcharges account for only 5 percent of the wastes treatment in 1968-1969 Greensboro's surcharge program recovered $0.

Lufkin Rule Company does not dispose of its industrial wastes in the municipal sewer system, but other small industries do use the system. The low flow of the receiving stream requires that all types of wastes be efficiently treated because they are not adequately diluted by the stream itself.

The League of Municipalities has drafted a model sewer surcharge ordinance which establishes procedures and regulations for the disposition of industrial effluents within the system, though the ordinance only includes "guideline" figures to be considered as cutoff levels of concentration between normal and strong wastes. Assistance in the development of these standards can be provided by L. E. Wooten and Company and the waste treatment plant operator. Data on the character of industrial effluents is being gathered now for the design of Apex's expanded treatment plant by the consulting engineer. The necessity for this type of regulation will be determined on the basis of that analysis.

APPENDIX A

NORMAL CONSUMPTION AND POPULATION PROJECTIONS

Apex's dramatically higher growth rate between the 1966 Special Census and 1970 Census suggests that Apex may now be entering a period of extended rapid growth. If growth continues at this rate, Apex's population will grow in accord with the "high" projection illustrated in the graph on the following page. For isolated smaller towns, such fluctuations occur as single industries open or close and bear no import as trend indicators. Apex is not, however, an isolated small town, but is Raleigh's most distant "satellite town", and because of this, population trends in Apex are not solely a function of the town's basic industrial and commercial growth or decline.

The graph on the page following illustrates the actual population growth of Cary, Garner, and Apex as well as projected population data prepared by the Research Triangle Regional Planning Commission in the 1969 Research Triangle Land Development Guide. Growth in Cary and Garner was only slightly higher than projected, but Apex demonstrated a significantly higher rate of growth; exhibiting a trend similar to those established by Cary and Garner twenty years prior. Because this change has only occurred over a four-year period and not the entire decade, it cannot be unquestioningly assumed that the new increased rate of growth will be sustained, and more conservative estimates must be used in the planning of public works. For this reason the intermediate projection line will be taken as a guide for purposes of this study.

The population estimates used in the computation of normal consumption requirements are based upon the intermediate projection line for Apex, which represents the average rates of growth for Cary and Garner between 1950 and 1970, extended forward from Apex's 1970 population. Apex's actual growth will probably be somewhat slower until 1973 because of the inability of the water and sewer systems to accommodate further growth at this time. The completion of Raleigh's beltline will probably serve as a stimulus to growth in the latter part of the decade in Apex, as will the completion of four-lane construction on U.S. 1 between Wake County and Sanford.

APPENDIX A

NORMAL CONSUMPTION AND POPULATION PROJECTIONS

Ahmad's alternatively higher growth rate between the 1950 Census and 1970 Census suggests that Ahmad may use as contrast a period of extended rapid growth. If growth continues at this rate, Ahmad's population will triple every 15 years. Ahmad's actual growth will follow in accord with the "high" projection illustrated in the Graph on the following page. If growth continues at this rate, Ahmad's population will double every 10 years. Ahmad's 1970 population. Ahmad's actual growth will extended from Ahmad's 1970 population. Ahmad's actual growth will triple by somewhere around until 1973 because of the inadequacy of the water and sewer systems to accommodate further growth at this time. The combination of Ahmad's geriatric population structure as a stimulus to growth in the latter half 2000 of Ahmad's population will probably scale as the combination of long-term construction and water supply and sewer and Ahmad.

Long Range Growth Prospects. Growth in Cary and Garner are only slightly higher than Ahmad's demonstrated a significantly higher rate of growth when projected, but Ahmad's experience suggests that this combination of Cary and Garner growth exhibiting a trend similar to those established by Cary and Garner through the 1960 Census. Because this change has only occurred over a long-term period, it cannot be unconditionally assumed that the recent trend of growth will be sustained, and more conservative estimates may be used in the beginning of simple models. For this reason the intermediate projection line will be taken as a guide for purposes of this study.

The population estimates used in the combination of normal consumption requirements are based upon the intermediate projection line for Ahmad. Water requirements are based upon the intermediate projection line for Ahmad's 1970 population. Ahmad's actual growth will extended from Ahmad's 1970 population. Ahmad's actual growth will triple by somewhere around until 1973 because of the inadequacy of the water and sewer systems to accommodate further growth at this time. The combination of Ahmad's geriatric population structure as a stimulus to growth in the latter half of the decade in Ahmad's as will the combination of long-term construction water supply and sewer and Ahmad.

Long Range Growth Prospects. Growth in Cary and Garner are only slightly higher than Ahmad's demonstrated rate of growth when projected, but Ahmad's experience suggests that this combination of Cary and Garner growth exhibiting a trend similar to those established by Cary and Garner through the 1960 Census. Because this change has only occurred over a long-term period, it cannot be unconditionally assumed that the recent trend of growth will be sustained, and more conservative estimates may be used in the beginning of simple models. For this reason the intermediate projection line will be taken as a guide for purposes of this study.

The Graph on the back following illustrates the normal population growth of Cary, Garner, and Ahmad as well as projected population data provided by the Research Triangle Regional Planning Commission in the 1969 Research Triangle Land Development Guide. Growth in Cary and Garner are only slightly higher than Ahmad's "natural" and because of this, population changes in Ahmad are not solely a function of the town's basic industrial and commercial growth or decline.

The Graph on the back following illustrates the normal population growth of Ahmad, Cary, Garner, and Ahmad as well as projected population data provided by the Research Triangle Regional Planning Commission in the 1969 Research Triangle Land Development Guide. Growth in Cary and Garner are only slightly higher than Ahmad's "natural" and because of this, population changes in Ahmad are not solely a function of the town's basic industrial and commercial growth or decline.

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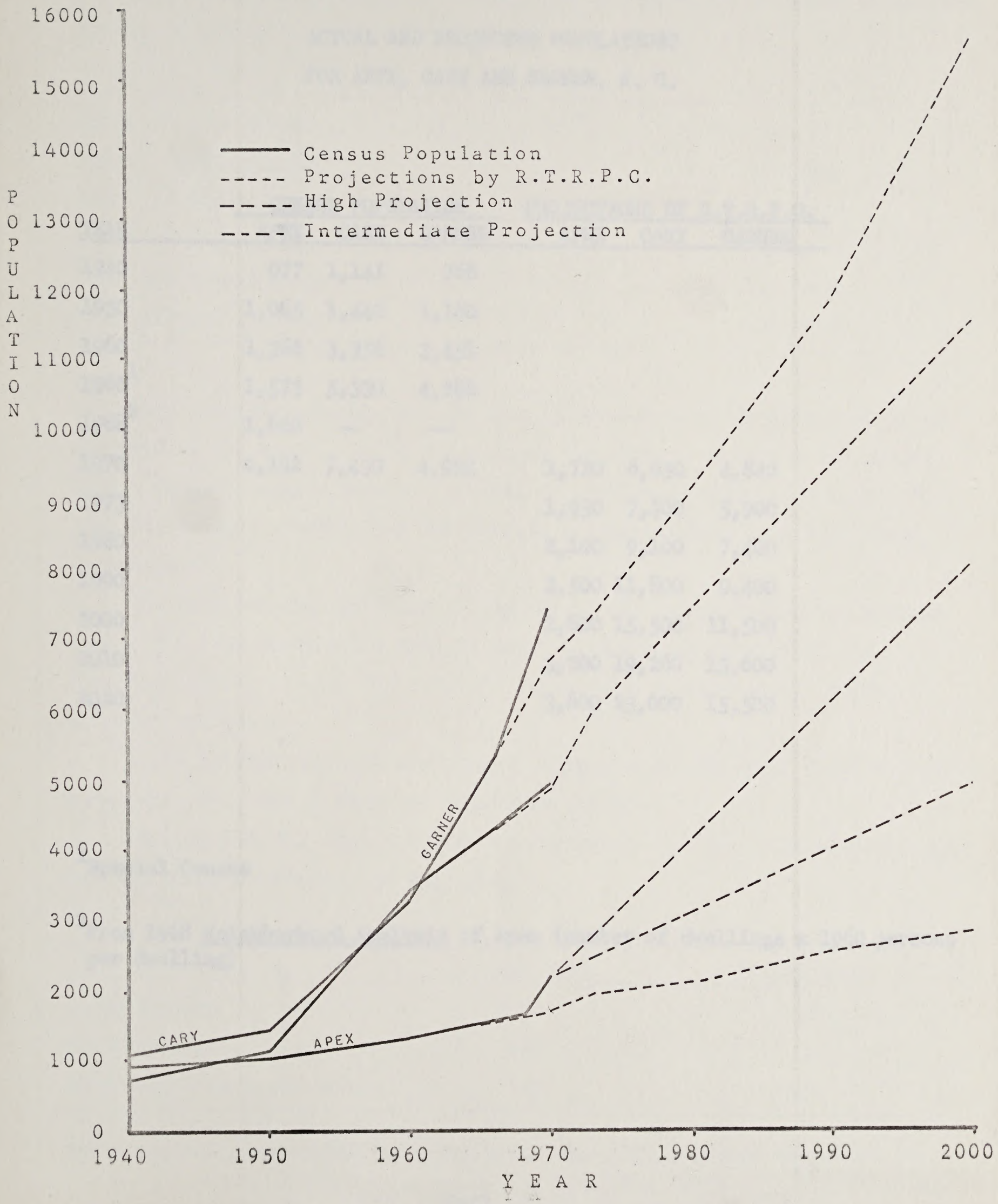
APEX, CARY, AND GARNER, N. C. POPULATION AND PROJECTIONS



ACTUAL AND PROJECTED POPULATIONS

FOR APEX, CARY AND GARNER, N. C.

YEAR	CENSUS POPULATION			PROJECTIONS BY R.T.R.P.C.		
	APEX	CARY	GARNER	APEX	CARY	GARNER
1940	977	1,141	768			
1950	1,065	1,446	1,180			
1960	1,368	3,356	3,451			
1966[1]	1,573	5,330	4,282			
1968[2]	1,668	—	—			
1970	2,192	7,430	4,923	1,720	6,650	4,840
1973				1,950	7,300	5,900
1980				2,100	9,100	7,400
1990				2,500	11,800	9,400
2000				2,800	15,500	11,500
2010				3,200	19,260	13,600
2020				3,600	23,000	15,500

[1] Special Census

[2] From 1968 Neighborhood Analysis of Apex (number of dwellings x 1960 persons per dwelling)

[Special Census]

[From 1961 Nationalized Analysis of Area (number of quantities x 1000 persons per quantity)]

YEAR	CENSUS POPULATION			PROJECTIONS BY N.T.N.P.C.		
	VAEX	CVAX	CVAMEN	VAEX	CVAX	CVAMEN
1960	1,962	1,741	762			
1961	1,960	1,945	1,051			
1962	1,955	2,330	4,583			
1963	1,913	2,315	4,521			
1964	—	—	—			
1965	1,999					
1966	1,961	2,430	4,653	1,650	2,300	5,600
1967				1,750	2,500	4,840
1968				1,800	2,600	4,900
1969				1,900	2,700	5,000
1970				2,000	2,800	5,100
1971				2,100	2,900	5,200
1972				2,200	3,000	5,300
1973				2,300	3,100	5,400
1974				2,400	3,200	5,500
1975				2,500	3,300	5,600

FOR VAEX, CVAX AND CVAMEN IN C

VOLUME AND PROJECTED POPULATIONS

APPENDIX B

FINANCIAL ANALYSIS

Apex currently provides finished water to consumers at prices determined by the following rate schedule:

First	1,000 gallons	$3.00
Next	4,000 gallons	.75 per m
Next	5,000 gallons	.55 per m
Next	40,000 gallons	.35 per m
Next	150,000 gallons	.30 per m
Over	200,000 gallons	.25 per m

Bills are rendered monthly, are due when presented and are delinquent after the 10th of the month. Bills not paid on the 25th of the month are subject to a 5 percent penalty charge. Service is terminated when bills become 60 days delinquent. Water rates for certain industries have been negotiated in the past.

The only revenues accruing in support of the sewage system are tapping fees. The town contributed $200 to property owners not served by the municipal sewers towards the costs of septic tank installation. There is no sewer use charge.

Users outside the town are charged rates one and one-half times the inside rate (except in the instance of negotiated rates).

Tapping fees for 3/4" services are dependent upon the road surface type, and are charged according to this scale:

	PAVED ROAD	UNPAVED ROAD
Water Service	$ 76	$ 58
Sewer Service	108	90
Water and Sewer (concurrent)	150	125

For oversized connections, material costs above those listed are added.

NOT OVERSIZED CONNECTIONS: METERED COSTS APPLY EXCEPT WHEN FLAT RATE APPLIED.

	PAYED BOND	UNPAYED BOND
Water Rates	$ 19	$ 28
Sewer Rates	108	90
Water and Sewer (combined)	120	152

Bills are rendered monthly, rate due when presented and are delinquent after the 15th of the month. Bills not paid on the 25th of the month are applied to a 5 percent penalty charge. Service is terminated when bills become 60 days delinquent. Water rates for certain industries have been negotiated in the past.

The only revenues secured in support of the sewage system are penalty fees. The rows contributed $300 to property owners not served by the municipal sewers consists the costs of septic tank installation. There is no sewer use charge.

Rates contain the form of charged rates one and one-half times the minimum rate (except in the instance of negotiated rates).

Penalty fees for 3\4" services are delayed upon the road surface cave-in rate charged according to this scale:

First	1,000 Gallons	$3.00
Next	4,000 Gallons	.12 per m
Next	5,000 Gallons	.22 per m
Next	40,000 Gallons	.35 per m
Next	150,000 Gallons	.30 per m
Over	200,000 Gallons	.25 per m

Water consumption provides limited water to consumers at prices determined by the following rate schedule:

FINANCIAL ANALYSIS

APPENDIX B

There is no benefit-assessment policy for the installation of water or sewer lines.

Examination of the town's audits in recent years indicates at a glance that the combined water and sewer department operates at a healthy profit, since in each year substantial sums are transferred to the General Fund after operating costs are paid out. This fund transfer obscures the facts of the financial operation, however, for it is not balanced by an equivalent expenditure from the General Fund to the Debt Service Fund to retire debt for water and sewer facilities. (All of the town's current obligations were issued for water and sewer improvements.) Debt service is financed instead by a fractional component of the ad valorem tax levy, an equivalent proportion of the towns intangibles tax receipts from the state, and interest on certain investments. This practice represents poor management, because it fails to disclose readily the true financial status of a town function, which is actually operating with an annual deficit of $20,000 - $30,000 when debt service is accounted. Further, all citizens of the town are (through ad valorem taxes) paying for the support of these utilities though all of the town does not receive water and sewer service. This should be remedied by levying additional ad valorem taxes to support General Fund Activities, eliminating the ad valorem levy for Debt Service, and transferring net revenues from these two utilities to the Debt Service Fund. Obviously a small ad valorem levy for Debt Service must be maintained until the Water and Sewer Department can be made self-supporting.

WATER AND SEWER REVENUES AND COSTS, APEX, N. C.

1960 - 1970

FISCAL YEAR ENDING	WATER REVENUE	WATER OPERATING COSTS	SEWER REVENUES	SEWER OPERATING COSTS	WATER AND SEWER DEBT SERVICE	COMBINED WATER AND SEWER REV.	OPERATING AND DEBT SERVICE COMBINED WATER AND SEWER TOTAL COSTS	(+) SURPLUS OR (-) DEFICIT
1960	$18,418	$20,188	---	---	$ 7,925	---	---	---
1961	22,743	25,084	---	---	7,730	---	---	---
1962	26,941	29,656	---	---	7,555	---	---	---
1963	28,318	21,463	---	---	7,380	---	---	---
1964	34,331	27,430	---	---	10,511	---	---	---
1965	32,923	31,361	---	---	34,842	---	---	---
1966	35,077	20,391	$2,310	$14,158	36,617	$37,387	$ 71,166	-$33,779
1967	38,066	17,352	630	12,143	36,754	38,696	66,249	- 27,553
1968	51,303	20,595	1,362	11,769	35,884	52,663	68,248	- 15,585
1969	77,919	45,869	5,269	13,632	46,847	83,188	106,348	- 23,160
1970	86,869	39,212	2,910	25,670	45,669	89,779	110,551	- 20,772

WATER AND SEWER REVENUES AND COSTS, APEX, N. C.

1960 - 1970

FISCAL YEAR ENDING	WATER REVENUE	WATER OPERATING COSTS	SEWER REVENUES	SEWER OPERATING COSTS	WATER AND SEWER DEBT SERVICE	COMBINED WATER AND SEWER REV.	OPERATING AND DEBT SERVICE COMBINED WATER AND SEWER TOTAL COSTS (+) (-)
1960	$18,418	$20,188	—	—	$ 7,925	—	—
1961	22,743	25,084	—	—	7,730	—	—
1962	26,941	29,656	—	—	7,555	—	—
1963	28,318	21,403	—	—	7,380	—	—
1964	34,331	27,430	—	—	10,511	—	—
1965	32,923	31,361	—	—	34,842	—	—
1966	35,077	20,391	$2,310	$14,158	36,617	$37,387	$ 71,165
1967	38,066	17,352	630	12,143	36,754	38,696	66,249
1968	51,303	20,595	1,362	11,769	35,884	52,663	68,248
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1970	86,869	39,212	2,910	25,670	45,669	89,779	110,551

Suggested Techniques for Achieving Self-Supporting Water and Sewer Service

The Municipal Water and Sewer Department should become a self supporting operation wholly funded by those using these services, currently these systems are partially supported by property taxes, which are levied to retire debt for their facilities. As much of the cost of operation and debt repayment as feasible should be borne by those who consume water and generate fluid wastes requiring treatment, and these costs should be equitably distributed according to demands placed on the system by the user (e.g. according to water consumed and sewage treatment demand generated).

Several suggestions follow which can be used to render the operation of the water and sewer systems on sound financial footing and eliminate the existing financial inequities. The Town Board should carefully consider these methods and adopt, as official policies for the Town, those which are most feasible.

Septic Tanks

Apex has adopted a policy under which the town pays to property owners whose land cannot currently be serviced by sewer lines two-hundred dollars towards the costs of purchasing and installing a privately-owned septic tank and nitrification lines. This practice is objectionable for three basic reasons:

1) It sustains the use of septic tanks within the city limits, which the town should be discouraging, rather than subsidizing.
2) It places the town in the position of the land developer, since the tank itself adds value to the private property and is an irrecoverable "sunk" cost.
3) Municipal monies are expended for installing septic tanks rather than extending and improving sewer service.

This policy is in contravention with current municipal-developer relations throughout the state (municipalities are increasingly placing full cost for land improvement on developers through subdivision regulations). The Town should discontinue this policy.

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Several suggestions follow which can be used to render the operation of the water and sewer systems on sound financial footing and eliminate the existing financial inequities. The Town Board should carefully consider these methods and adopt, as official policies for the Town, those which are most feasible.

Septic Tanks

Ayer has adopted a policy under which the town pays to property owners whose land cannot currently be serviced by sewer lines two-hundred dollars towards the costs of purchasing and installing a privately-owned septic tank and microfilteration lines. This practice is objectionable for three basic reasons:

1) It sustains the use of septic tanks within the city limits, which the town should be discouraging, rather than subsidizing.

2) It places the town in the position of the land developer, since the tank itself adds value to the private property and is an irrecoverable "sunk" cost.

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Rate Schedules

Probably the simplest technique for the generation of additional revenues from utility operations is the adjustment of rate schedules. The following graph shows that Apex's rates are nearly as high as they can be set while remaining competitive with other municipalities in the same population group. The practice of negotiating rates (especially for commercial or industrial users outside the municipality) should be discontinued.

Water customers outside the municipality are charged one and one-half the inside users rate. In some towns of comparable size the outside rate is as high as twice the inside rate. Since Apex has just reduced the outside user rate factor from 2.0 to 1.5, a change in this police is not suggested at this time, but might be incorporated in any future general revision of the rate structure.

Subdivision Regulations

Apex's Subdivision Regulations do not currently require that developers bear the cost of water and sewer lines to service new subdivisions. Currently Apex installs lines to reach new subdivisions at the town's expense; the town should require that lines distributing water and collecting fluid wastes in new development be constructed according to the town's material standards, but their installation costs should be borne by the developers of these new subdivisions. (The institution of such a policy could have the effect of slowing growth down somewhat, because developers would lose some profit under this policy and perhaps choose to develop land elsewhere. The policy recommended is comparable to those in effect in neighboring towns and in Raleigh). Extensions of municipal lines necessary to serve these areas can be installed by municipal forces at the subdivider's expense. An acreage fee rebate system can be employed to provide reimbursement to developers as properties along these extensions are developed. The use of such a policy helps to reduce "leapfrog" development of new subdivisions too distant from the town to be economically provided with other municipal services.

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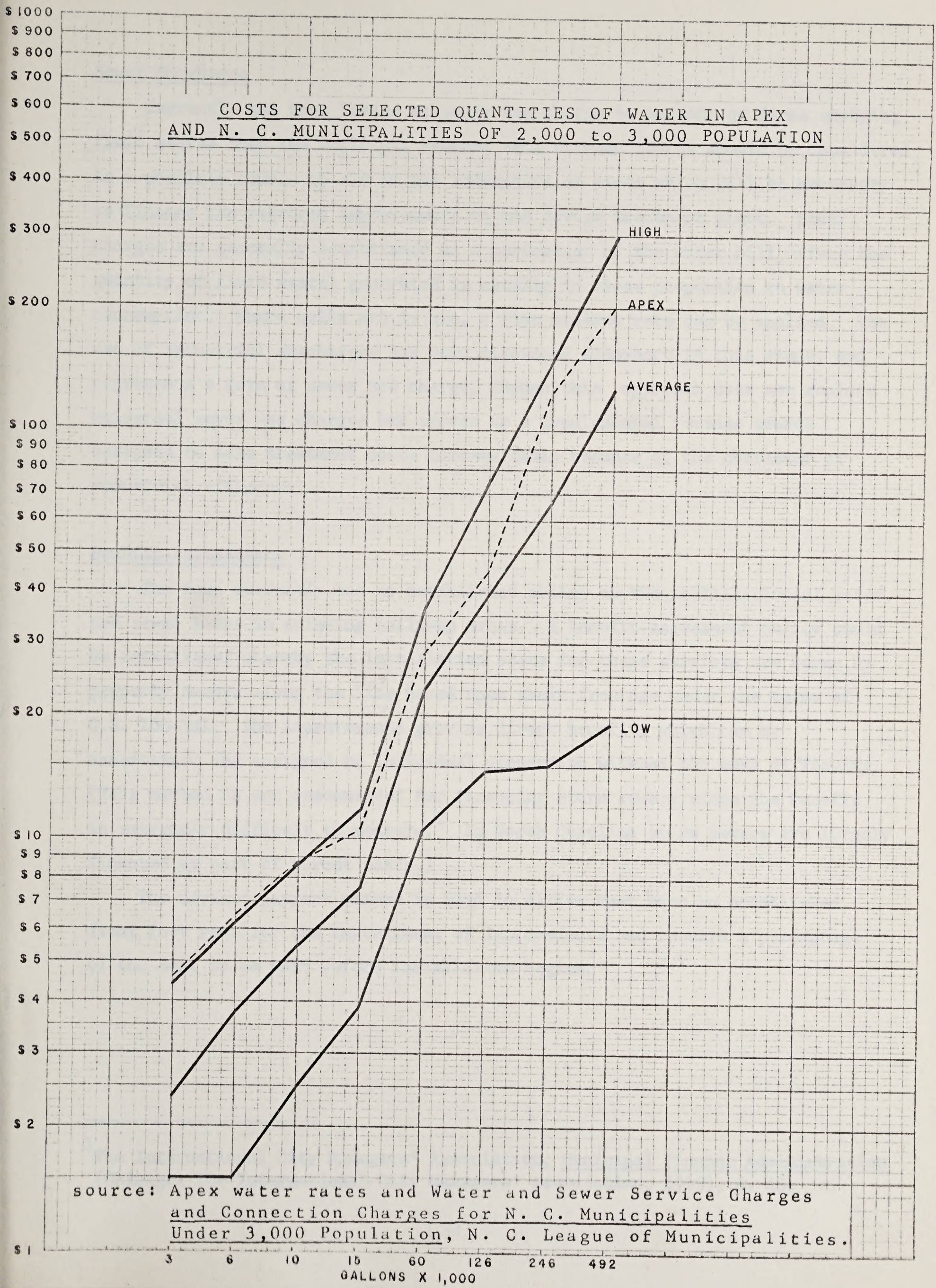

source: Apex water rates and Water and Sewer Service Charges and Connection Charges for N. C. Municipalities Under 3,000 Population, N. C. League of Municipalities.

Sewer Surcharge

Currently the town levies no sewer use charge to persons or firms emptying fluid wastes into the municipal sewers; this revenue source should be considered as a possible source to aid in the redemption of bonds which will be necessary to finance the required improvements to the sewage treatment plant. Sewer charges are generally established as a percentage of the water bill, since the quantity of fluid wastes generated is usually in close proportion to water consumption. Where wells are in use, a flat minimum rate can be applied. The use of industrial surcharges has been discussed elsewhere in this study, and represents a form of sewer use charge, though this approach does not replace universal sewer use charges but serves as a supplemental revenue source designed to make treatment costs more equitable because of the character of industrial effluents.

Benefit-Assessments

The town currently has no established policy on the installation of water and sewer lines in existing built-up areas. A benefit-assessment policy could be established whereby the installation costs for these services are borne by property owners along the line based upon their frontage under the terms of G.S. 160-241. The improvements provide direct benefits which can be ascertained and assigned to individual properties without too much difficulty. (This method is not recommended for financing storm sewers since the benefit is extremely difficult to measure.[1] In North Carolina storm sewers are largely financed as part of street costs.)

The advance payment method is used in cities that have an established front foot rate for the installment of improvements and require a percentage of the cost to be paid before installation begins.

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[1] The International City Managers' Association, Municipal Finance Administration (Chicago: The International City Managers' Association, 1962), p. 43.

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Benefit-assessments are particularly helpful in rapid-growth situations: if a town has a slow growth rate, it can meet the expenses of all improvements without much difficulty through general taxes and utility rates; however, rapid growth requires too much outlay for capital items. Eventually the town will need to expand its water works or some other major community facility, and will not be in financial condition to do so. In a rapid growth situation, special assessments have many desirable aspects:

1) The cost falls where the benefit lies.
2) Churches, private schools, and other governmental units are not exempt from special assessments (but are exempt from ad valorem taxes).
3) Priorities become very difficult to determine when improvements are borne by general tax funds. When special assessments are used, priorities are established by those property owners willing to participate in the cost.

There are three disadvantages to special assessments:

1) It is often difficult to apportion the cost of improvements fairly. Irregularly shaped lots are often assessed costs which are not in proportion to the benefit received if a "front foot" rule is applied; (acreage listed for tax purposes would provide a better measure, but the "front foot" rule is required by general statutes).[2]
2) Administration and collection is sometimes complicated and difficult.[1]
3) Rental properties in general (and Black and slum areas in particular) may fail to receive facilities for many years, contributing to the general decline of these neighborhoods and their property value (and assessed value for taxes).

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[1] Warren J. Wicker, "Local Improvement Financing" Institute of Government, (Chapel Hill, 1961), p.4.

[2] Alternate methods of accounting assessments were enacted as general municipal enabling legislation by the 1971 General Assembly; these will enable more equitable assessments where such lots are involved.

---

[1] Walter J. Wicker, "Local Improvement Financing: Instrument of Government" (Chapel Hill, 1961), p.4.

[2] "Alternate methods of accounting assessments were checked as General Manager Charlton helpfully pointed out the 1961 General Assembly: these will enable more equitable assessments where such funds are financed."

Acknowledgements

Carl P. Holleman, Town Attorney, Town of Apex

Mr. Julian Taylor, N. C. Department of Water & Air Resources

Mr. Thomas G. Horton, N. C. Department of Water & Air Resources

Mr. Fred Davis, Fred Davis Consulting Engineers

Mr. Willis Barlowe, L. E. Wooten Consulting Engineers

Mr. Tom Harris, Wake County Water Shed Commission

Mr. Charles Van Oersdall, Lufkin Industries

Mr. Buck Kennedy, L. E. Wooten and Company

References

An Economic Study of the Effect of Municipal Sewer Surcharges on Industrial Wastes, Don Ethridge, Water Resources Research Institute of the University of North Carolina

Proceedings: Workshop on Water and Sewer Charges as Related to Water Use and Waste Control, Water Resources Research Institute of the University of North Carolina, 1969.

Geology and Ground Water Resources in the Raleigh Area, North Carolina, Division of Ground Water, N. C. Department of Water and Air Resources, 1968.

Report on Additional Water Supply for Town of Apex, N. C., L. E. Wooten and Company, Consulting Engineers, 1969.

Report on Water Service to Town of Apex for Town of Cary, Moore, Gardner, and Associates, 1970.

Water and Sewer Service Charges and Connection Charges for N. C. Municipalities Under 3,000 Population, N. C. League of Municipalities, 1966.

Bibliography

Carl P. Hollsman, Town Manager, Town of Apex

Mr. Lindsay Taylor, N. C. Department of Water & Air Resources

Mr. Thomas O. Horton, N. C. Department of Water & Air Resources

Mr. Fred Davis, Fred Davis Consulting Engineers

Mr. Willis Dellinger, L. E. Wooten Consulting Engineers

Mr. Tom Hartis, Wake County Water Shed Commission

Mr. Charles Ann Cornell, Louise Industries

Mr. Mark Kennedy, L. E. Wooten and Company

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An Economic Study of the Effect of Municipal Sewer Surcharges on Industrial Water, Don Eckhardt, Water Resources Research Institute of the University of North Carolina

Proceedings: Workshop on Water and Sewer Charges as Related to Water Use and Waste Control, Water Resources Research Institute of the University of North Carolina, 1980.

Report on Water Surcharge to Town of Apex for Town of Cary, Moore, Carlson, and Associates, 1970.

Water and Sewer Service Charges and Connection Charges for N. C. Municipalities, N. C. League of Municipalities, 1969.

Report on Additional Water Supply for Town of Apex, N. C., L. E. Wooten and Company, Consulting Engineers, 1969.

Drainage of Crooked Water, N. C. Department of Water and Air Resources, 1968.

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PREPARED FOR

THE TOWN OF APEX

E. B. Tindal, Jr., Mayor

TOWN BOARD OF COMMISSIONERS

James Austin
Larry Jordan
Jerry Patrick
Baswell Markham
Edward O. Seagroves

Jesse Forrest, Town Manager

TECHNICAL ASSISTANCE FROM

THE STATE OF NORTH CAROLINA

DEPARTMENT OF LOCAL AFFAIRS

G. Irvin Aldridge, Director

DIVISION OF COMMUNITY PLANNING

George J. Monaghan, Administrator

CENTRAL AREA OFFICE

Blan W. Hale, Director

Robert W. Upchurch, Project Planner and Report Author